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OFFICE OF THE SECRETARY

November 20, 1997

NOTICE OF EX PARTE PRESENTATION

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M Street, NW
Washington, DC 20554

Re: *In the Matter of Application by SBC Communications Inc., Southwestern Bell Telephone Company, and Southwestern Bell Communications Services, Inc. d/b/a Southwestern Bell Long Distance for Provision of In-Region, InterLATA Services in Oklahoma, CC Docket No. 97-121 and In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98*

Dear Mr. Salas:

In accordance with the Commission's rules governing ex parte presentations, please be advised that yesterday, Liam Coonan, Martin Grambow, Paul Mancini, Roger Toppins, Kelly Murray, Dale Lundy, Mike Moore, Charles Cleek, Dale Lehman, Ph.D., Mike Auinbauh, Jane Hickie, and the undersigned, representing SBC Communications Inc., Southwestern Bell Telephone Company, and Southwestern Bell Communications Services, Inc., met with Rich Lerner, Ed Krachmer, Anu Seam, and D. Mark Kennet, Ph.D. of the Common Carrier Bureau's Competitive Pricing Division and Jake Jennings and Michael Kende of the Bureau's Policy and Program Planning Division in connection with the above-reference dockets. Also present at the meeting were several members of the Department of Justice's Antitrust Division.

The purpose of the meeting was to discuss general cost study methodologies and application of Southwestern Bell's total element long run incremental cost (TELRIC) studies to unbundled local loops. Southwestern Bell demonstrated that its TELRIC studies for unbundled network elements comply fully with the Communications Act of 1934, as amended, and the Commission's rules and decisions interpreting the Act. The attached materials served as a basis and reference for our discussion. Other than the attached materials, the presentation did not include any new arguments or information not already reflected in SBC's filings in the proceedings.

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In accordance with the Commission's ex parte rules, an original and one copy of this notice and the attachments are submitted for each docketed proceeding. Should you have any questions concerning the foregoing, do not hesitate to contact me.

Very truly yours,

Todd F. Silbergeld

Todd F. Silbergeld
Director-Federal Regulatory

Attachments

cc: Mr. Lerner
Mr. Krachmer
Ms. Seam
Dr. Kennet
Mr. Jennings
Mr. Kende

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Description of Unbundled Network Element Cost Studies

Southwestern Bell Telephone Company
St. Louis, Missouri

August 28, 1997

Table of Contents

1.0 Introduction

1.1 Purpose of this Document	5
1.2 Cost Study Requirements	5
1.3 Overview of Study Process	6
1.4 Listing of Unbundled Network Element Cost Studies	7

2.0 General Approach

2.1 The Cost Question	8
2.2 Study Flow	9

3.0 Unbundled Loop Costs

3.1 Study Purpose	11
3.2 Loop Components	12
3.3 Study Flow - Recurring Monthly Costs	14
3.4 Loop Samples	15
3.5 Cable Investment / Pair-Foot	16
3.6 Cable Mix Measurement	17
3.7 Fill Factor Estimation	18
3.8 LPVST Model	18
3.9 Digital Loop Carrier Investment	19
3.10 Other Loop Components	20
3.11 Automated Cost Extraction System (ACES)	21
3.12 Non-Recurring Costs	25
3.13 Other Loop Costs	25

4.0 End Office Switching Costs

4.1 Study Purpose	26
4.2 Study Flow	27
4.3 Switching Cost Information System	30
4.4 Feature-Related Hardware	31
4.5 Dial Equipment Minutes of Use	31
4.6 Other End Office Switching Costs	32

5.0 Transport Costs

5.1 Study Purpose	34
5.2 Dedicated Transport	34
5.3 Entrance Facilities Costs	35
5.4 Interoffice Facility Costs	36

5.5 Common Transport 38
5.6 Other Transport Network Element Costs 40
5.7 Non-Recurring Transport Costs 40

6.0 Operator Services

6.1 Study Purpose 41
6.2 Operator Work Second Costs 41
6.3 Directory Assistance Costs 42
6.4 Local and IntraLATA Operator Assistance - Fully Automated 42
6.5 Call Trace Costs 43
6.6 External Rating / Reference Costs for Facility-Based Providers 43
6.7 Branding Costs for Facility-Based Providers 44
6.8 Directory Assistance Call Completion 44

7.0 Other Network Element Costs

7.1 Overview 45
7.2 Tandem Switching 45
7.3 Signaling System 7 45
7.4 Unbundled Service Order 46
7.5 Maintenance of Service 47
7.6 Operational Support Systems 48

8.0 Capital Costs

8.1 Definition of Capital Costs 50
8.2 Capital Cost Calculation 50

9.0 Investment Loadings

9.1 Definition of Investment Loadings 54
9.2 Description 54
9.3 Inflation Factors 55

10.0 Operating Expense Factors

10.1 Definition of Operating Expenses 56
10.2 Description of Operating Expense Factors 56

11.0 Forward-Looking Common Costs

11.1 Definition of Forward-Looking Common Costs 58
11.2 Common Cost Calculation and Allocation 58

Appendices

A. Summary of Unbundled Network Element Cost Studies - Oklahoma

Introduction

1.1 Purpose of this Document

The purpose of this document is to describe the studies made by Southwestern Bell to determine the costs of providing unbundled network elements in compliance with the Federal Communications Commission order in CC Docket No. 96-98.[1] A network element is "a facility or equipment used in the provision of a telecommunications service."[2] Costs determined in these studies are used in establishing proposed unbundled network element prices. This document describes the study methods, models, input data and results.

1.2 Cost Study Requirements

According to the Final Rules of the FCC Order, "An incumbent LEC must prove to the state commission that the rates for each element it offers do not exceed the forward-looking economic cost per unit of providing the element, using a cost study that complies with the methodology set forth in this section and 51.511 of this part." (Page B-30 - B-31, Appendix B of Order.)

The FCC defined *forward-looking economic costs* as the sum of *total element long-run incremental costs (TELRIC)*, plus a reasonable allocation of *forward-looking common costs*. The Order calls for local exchange carriers to develop cost studies which compute TELRICs for network elements, forward-looking common costs and a reasonable allocation scheme for common costs.

In specifying the costing methodology for TELRIC, the FCC laid out the following conditions for cost studies.

- *Efficient network configuration*. Studies are to reflect forward-looking, efficient network technologies and configurations recognizing existing wire center locations.

- *Forward-looking cost of capital*. Capital costs are to reflect the costs of debt and equity anticipated in the future.

- *Depreciation rates*. Depreciation expense is to be based on economic depreciation rates and the economic lives of telephone plant.

Forward-looking common costs are to reflect costs efficiently incurred in providing a group of elements or services and are to exclude retail costs.

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[1] CC Docket No. 96-98, "In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996." August 8, 1996.

[2] Page B-10, Final Rules, Appendix B of the FCC Order.

The FCC ordered that certain factors not be considered in network element cost studies. These included embedded costs, retail costs and opportunity costs, as well as revenues to subsidize other services. These are the broad requirements specified by the FCC for cost studies. *Southwestern Bell's unbundled network element cost studies described in this document satisfy these requirements.*

1.3 Overview of Study Process

The Southwestern Bell cost study process has evolved over many years. Its purpose has been to determine the costs of offering new and existing services in order to set tariffed rates. The cost methodology which has been used is called *long run incremental costing*. This methodology determines the *direct costs* which will be incurred by Southwestern Bell in providing a service during a future planning period. These costs provide a floor for prices. They do not include costs which are common to services or network elements which must be recovered by prices which exceed incremental costs.[3]

The existing cost study process has been adapted to compute the costs of unbundled network elements consistent with the FCC requirements in CC Docket 96-98. For example, incremental costs are computed for the *total demand* of network elements, rather than an increment of the element. The study process also is modified to exclude certain operating expenses related to the retail marketing of services which would not apply to unbundled network elements.

However, many aspects of the study process remain the same.

- *Set of Cost Models*. Cost studies are performed using several cost models. Models such as LPVST and SCIS are used to compute the capital investment required to construct local loop facilities and switching systems, respectively. Another model, NCAT, is used to compute the tandem switching investment required to handle various tandem-routed calls through Southwestern Bell's switched network. CAPCOST is used to compute book depreciation, the cost of money and income taxes associated with plant investment. Another model called ACES is used to aggregate the results of previous models and cost calculations to calculate final network element costs. In addition to these "standard" cost models, cost analysts develop worksheets, tables and other costing tools as part of the costing process.

- *Team of Cost Analysts and Subject Matter Experts*. The cost study process involves several cost analysts with specialties in network cost analysis, capital cost development and other aspects of the studies. In addition, the studies require input from subject matter experts in marketing, engineering and operations. The team approach provides more realistic and more accurate estimates of costs.

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[3] The Company has performed other types of cost studies, such as embedded cost studies and fully distributed cost studies. These studies generally have been used to determine historical costs of broad service categories or to determine jurisdictional "revenue requirements."

- *Real Network Characteristics*. Cost studies are "forward-looking" in the sense that they calculate the cost to provide unbundled network elements using the latest plant technology for local loop facilities, switching, and other elements of the network. At the same time the studies reflect relevant aspects of the existing network, such as locations of central offices and customer premises, traffic characteristics, and others. Based on these characteristics which determine the network today and influence it in the future, the studies calculate the plant investment and operating costs which would be expected using forward-looking technologies to satisfy the demand for network elements.

- *Forward-Looking Cost Data*. Along with using forward-looking plant technologies, the studies use plant cost data (vendor prices, labor costs, etc.), capital cost factors and operating expenses which are reflective of these forward-looking technologies.

- *Quality Assurance*. Finally, an important part of the cost study process is "quality assurance." Studies are reviewed several times for accuracy, consistency in the application of costing methods and cost data, and completeness.

1.4 Listing of Unbundled Network Element Cost Studies

Costs have been calculated for a number of unbundled network elements for each of the states in which Southwestern Bell operates. A summary of cost studies is provided in Appendix A.

General Study Approach

2.1 The Cost Question

In calculating unbundled network element costs, Southwestern Bell cost analysts answer the following question:

> *What are the forward-looking, long run incremental costs for a network element recognizing Southwestern Bell's existing network and using forward-looking, efficient technologies, with network maintenance and operations reflecting these technologies?*

The cost analyst calculates the cost to provide an unbundled local loop, a minute of use on a local switch or other network element, not based on existing plant, investment and operating expenses, but rather using forward-looking design for local loop facilities, all digital switching, and other plant.

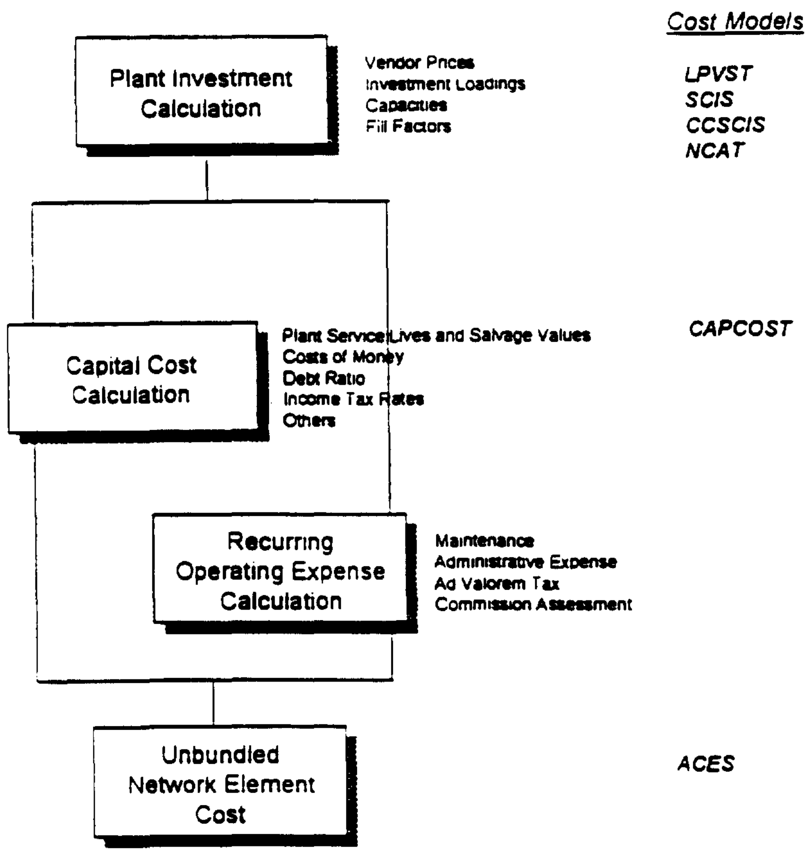
The cost analyst computes these forward-looking plant costs reflecting current vendor prices and discounts for equipment, current engineering and labor costs, etc. Plant maintenance and other operations reflect systems and procedures associated with these forward-looking technologies. In summary, unbundled network element costs reflect a forward-looking network operation designed to satisfy total demand, yet reflective of the way the network has evolved, particularly with regard to wire center locations.

Costs computed in this way are referred to as total element long run incremental costs (TELRIC). It is important to recognize that TELRIC is a special case of incremental costs. Incremental costs typically reflect differences in future plant costs and operating expenses due to relatively small differences in demand caused by introducing a new service or changing an existing service offering. TELRIC is the incremental cost of the total demand for a network element.

2.2 Study Flow

The general flow of the cost study is shown in Figure 2.1. The first step is to calculate the *plant investment per unit of a network element*.

Figure 2.1



The plant investment required to provide a network element consists of several (perhaps many) plant components. For example, the plant necessary for an unbundled local loop consists of parts of the main distributing frame in the central office, distribution and feeder cables, feeder-distribution interfaces, premises terminating equipment and others. Plant investments are computed for each component reflecting the mix of equipment used today to provide the component, appropriate equipment quantities, vendor prices, capitalized engineering and labor costs. support assets (such as power equipment and buildings) and others.

Plant investments per unit of a network element are then computed by dividing the plant investment necessary for each component by its *expected capacity utilization*. Expected capacity utilization is simply the *physical capacity* of the plant component multiplied by its *fill factor* or *utilization*. This gives a measure of the amount of investment which would be required using forward-looking technologies to provide a network element.

In the second step, *annual capital costs* are calculated. These include *depreciation expense* for the recovery of plant investment over its service life, a return requirement or *cost of money* associated with investor-supplied capital used to construct the plant, and an *income tax* obligation associated with the equity portion of the cost of money. Southwestern Bell computes capital costs using a model called CAPCOST.

Network element costs also include *recurring operating expenses* associated with the maintenance of plant, network administration functions, support assets, miscellaneous other operating taxes and a commission assessment on revenues received in providing network elements to other carriers. Operating expenses are computed using various expense factors which are unique to each type of plant, recognizing different levels of maintenance and network administration necessary for different plant types. Network element costs then are the sum of the recurring capital costs and operating expenses associated with the plant required to provide the network element.

In the Sections 3 - 6, the unbundled loop, end office switching, transport and operator services cost studies are described. The same general approach for computing network element costs is followed, although the study methods and procedures are adapted to the specific requirements of each study. Section 7 provides an overview of the other network element cost studies.

Unbundled Loop Costs

3.1 Study Purpose

The Unbundled Loop Cost Study calculates the cost to Southwestern Bell to provide an unbundled loop assuming a local network based on forward-looking plant technologies and costs of plant construction. A loop consists of the telephone plant from the *network interface device* at a customer's premises to the serving central office of Southwestern Bell. Loop costs are calculated for the following types of loops.

- *8db Loop*. A basic "two-wire" loop suitable for regular voice telephone service. Costs also are calculated for a four-wire loop.
- *Basic Rate Interface (BRI) Loop*. An Integrated Services Digital Network (ISDN) loop.
- *DS1 Loop*. A transmission path from the customer premises to the serving wire center capable of conveying digital signals of 1.544 megabits per second.

For each type of loop, costs are computed for three geographic zones corresponding with rural, mid-size and large, urban wire centers. Loop costs vary among the geographic zones due to differences in loop length, cable mixes and sizes, and other factors which vary among the zones.

Loop costs are expressed as a *recurring monthly cost* which includes capital costs (depreciation, the cost of money and income taxes) and operating expenses for ongoing plant maintenance, network administration and other activities. Non-recurring costs are computed for the activities necessary to provision unbundled loops and are distinguished for the first or initial unbundled loop versus additional loops. A separate non-recurring cost for service order processing also is computed. Figure 3.1 illustrates the costs calculated in the unbundled loop cost study.

In this document, the calculation of 8db two-wire loop costs is described, as well as the non-recurring provisioning and service order costs for the 8db loop. For details on the other loop costs refer to the Unbundled Local Loop Study documentation in each state.

Figure 3.1

Unbundled Loop Cost Study Results

Loop Recurring and Non-Recurring Costs

Type of Loop	Geographic Zone	Recurring Cost	Non-Recurring Cost Initial	Non-Recurring Cost Additional
8db Loop	1	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX
BRI Loop	1	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX
DS1 Loop	1	$XX.XX	$XX.XX	$XX.XX
	2	$XX.XX	$XX.XX	$XX.XX
	3	$XX.XX	$XX.XX	$XX.XX

Service Order Costs

Type of Loop	Geographic Zone	Recurring Cost	Non-Recurring Cost Initial	Non-Recurring Cost Additional
8db Loop	All	NA	$XX.XX	$XX.XX
BRI Loop	All	NA	$XX.XX	$XX.XX
DS1 Loop	All	NA	$XX.XX	$XX.XX

NA: Not Applicable

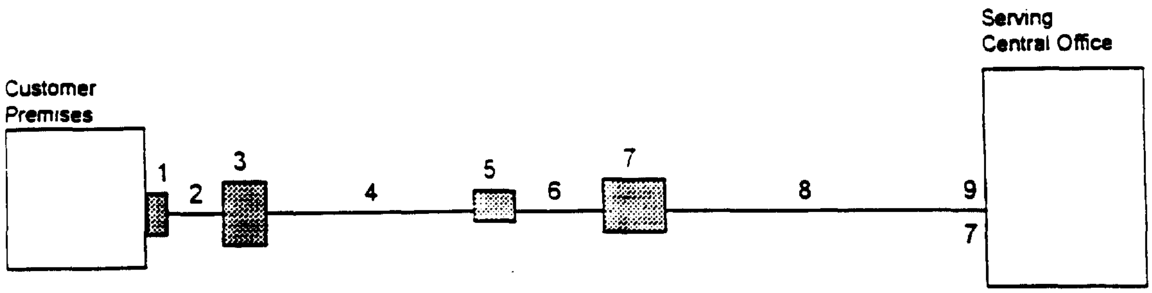
3.2 Loop Components

An 8db loop includes Southwestern Bell plant from the customer premises, through distribution and feeder cable facilities, to the main distributing frame in the serving central office. Figure 3.2 illustrates the components of an 8db loop.

- *NID, Drop Cable and Terminal.* The network interface device (NID), drop cable and terminal are referred to as *premises termination equipment* in the loop cost study. They provide the transmission path from the last cable spice in the outside plant network to the customer's premises. The 8db loop cost study recognizes two possible configurations of premises termination - one involving a singe pair of wires to the customer premises, and the other two pairs. A weighted average of costs for the two configurations is used in the study.

- *Distribution Cable.* The copper cable which runs from the feeder-distribution interface to the terminal located near the customers premises. *The feeder-distribution interface* is the "cross-connection" point between the feeder cable from the serving central office and the distribution cable. A mix of aerial, buried and underground cables is used in the study. The cable mix varies by geographic zone. Pole and conduit investment to support distribution cable also are included in the loop cost calculation.

Figure 3.2



1. Network Interface Device
2. Drop Cable
3. Terminal
4. Distribution Cable
5. Feeder-Distribution Interface
6. Feeder Stub
7. Digital Loop Carrier System
8. Feeder Cable
9. Main Distributing Frame Stringer

- *Feeder Stub and Digital Loop Carrier (DLC) System.* When loop feeder cable lengths exceed a certain threshold (typically 15,000 feet), fiber feeder cable and digital loop carrier systems are used in the cost study as the most efficient loop design. In this case a feeder stub or section of cable is required to connect the feeder cable to the DLC equipment.

  The digital loop carrier system requires circuit equipment located in the field. Approximately 75% of the time circuit equipment is required at the central office as well. The DLC equipment provides multiplexing of voice channels over the fiber cable between the serving central office and the feeder-distribution interface. The study assumes three system sizes with 192, 672 and 1,344 channels of capacity. The amount of DLC investment per loop depends upon the frequency of fiber versus copper feeder, the percentage of integrated DLC systems (which do not require central office terminating equipment), system size and expected utilization of the system (fill factor).

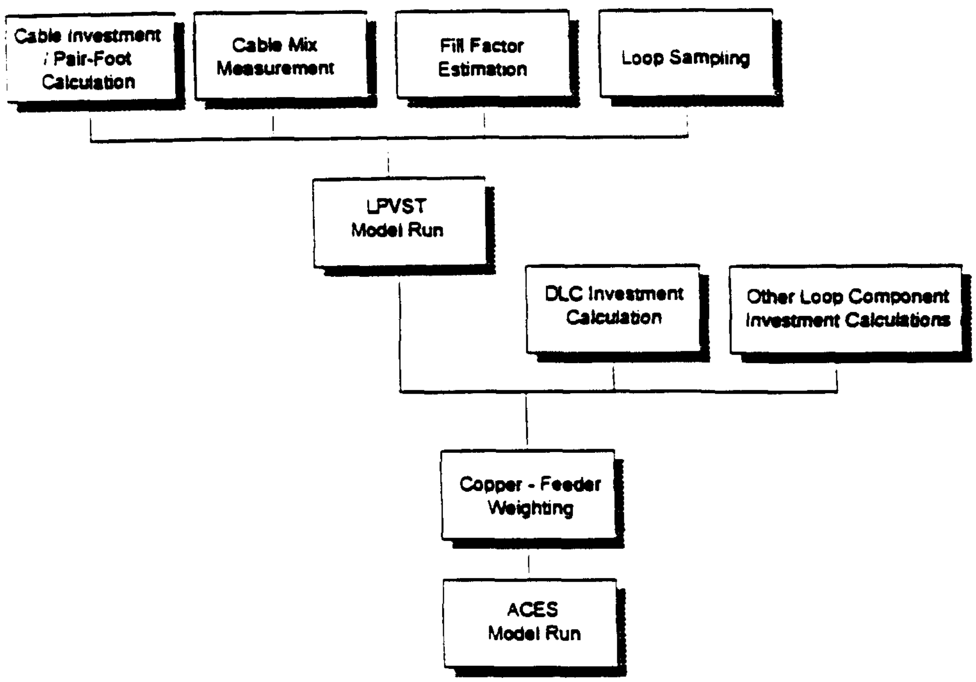
- *Feeder Cable.* Copper or fiber cable running from the serving central office to the feeder-distribution interface or remote DLC terminal. The cost study reflects a mix of aerial, buried and underground cables depending upon the geographic zone. Copper feeder is assumed for loops with feeder cable lengths less than 15,000 feet. As with distribution cable, pole and conduit plant investment is included in the loop cost calculation.

- *Frame Stringer.* Equipment connecting outside plant cables to the Main Distributing Frame. Includes a protector unit, protector block, riser cable and the labor cost to place the equipment.

3.3 Study Flow - Recurring Monthly Costs

As described earlier, loop costs include the *recurring monthly costs* Southwestern Bell incurs in providing loops and the *non-recurring costs* to process an unbundled loop service order and to provision the loop. In this section, the study flow for computing recurring monthly costs is described. The study flow is illustrated in Figure 3.3.

Figure 3.3



The loop cost study uses several interrelated models and special studies. LPVST is the primary model in the study. It is used to compute *the plant investment per loop for the distribution and feeder cable components* of the loop. Plant investments are computed for the three geographic zones based on loop characteristics in each zone. These characteristics include:

- *Loop length.* Samples of actual loops in service are used to determine average loop lengths in zones 1, 2 and 3. (See Section 3.4.)

- *Mix of cable types*. Different proportions of aerial, buried and underground cable are used in rural, mid-sized and urban wire centers. These are based on a study of cable types in service. (See Section 3.6.)

- *Installed cable costs per pair-foot* by cable type and wire gauge (26, 24, 22, and 19 gauge). Installed cable costs vary depending on the size of cable in terms of pairs per cable. Calculations are made to determine the mix of cable sizes, and based on this mix installed cable costs per pair-foot are determined for each combination of cable type and wire gauge. (See Section 3.5.)

- *Fill factors*. Other calculations are made to determine actual utilization levels for copper distribution cables, copper feeder cables and fiber feeder cables. (See Section 3.7.)

These characteristics are measured for the existing local facilities network. Adjustments then can be made if characteristics are expected to be different in the future. LPVST also determines investments in poles and conduit structures per loop based upon investment loading factors (See Section 9.)

In parallel with the calculation of distribution and feeder cable investments per loop, the investments in digital loop carrier systems and the other loop components are computed. The latter includes the premises termination equipment, feeder-distribution interface, feeder stub, and main distributing frame stringer. Each of these additional loop investments is calculated using a special study made by a cost analyst with input from subject matter experts in engineering.

3.4 Loop Samples

Loop length is a key driver of loop costs ... the longer the loop, the more plant investment is required. Since the object of the unbundled loop cost study is to determine the forward-looking cost to serve the total demand for loops, *average loop lengths* must be estimated for all loops in each geographic area.

Rather than measure the lengths of all loops, a representative sample is taken at random. In random sampling, the number of samples which must be taken to accurately measure the average of the population depends on several factors:

- *Variability*. The more loop lengths vary within a study area, the greater the chance the average loop length of a sample is significantly different than the true average. Sample sizes must be larger when loop lengths vary significantly. On the other hand, geographic areas which have less variance in loop lengths require smaller samples. Small sample sizes often provide very good estimates of the true average.

- *Confidence Interval*. When a sample is taken and the average loop length is computed, some assurance is needed that the true average is within a reasonable range around the sample average. Typically, a 95% confidence interval is used. This means the cost analyst can assume there is a 95% chance the true average is within this range. The confidence interval can be "tightened" to a satisfactory range by increasing the sample size.

- *Size of the Population*. The larger the population of loops the greater the chance a random sample will be representative. In Southwestern Bell studies loop populations typically number in the hundreds of thousands.

The sampling techniques used by Southwestern Bell determine proper sample sizes. Samples are taken at random from the Loop Engineering Information System (LEIS) database which maintains records of lines in service. The system records actual lengths of feeder cables and provides estimates of distribution cable lengths. Once a valid sample of several hundred loop lengths is obtained, the data are entered in the LPVST model to compute average feeder and distribution cable investments per loop.

3.5 Cable Investment / Pair-Foot

Cable costs are measured by linear foot and vary by *cable type*, *wire gauge* and *cable size*. For example, assume a foot of buried cable with 26 gauge wire in a 200 pair cable size has a installed cost of approximately $5.00. This figure includes the cable material, telco engineering and labor, miscellaneous materials and contractor charges for placing the cable. Similarly, assume 26 gauge, 300 pair buried cable costs about $1.00 more per foot, or $6.00.[4]

Loop cable plant is made up of numerous sections of cable of various cable type, wire gauge and cable size. To calculate loop investments it is necessary first to compute a cable cost for the mix of cable sizes in a geographic zone. This figure is expressed as an *cable investment / pair-foot of cable capacity*. Separate investments / pair-foot are computed for each cable type and wire gauge. These *unit investments* are applied to the average loop lengths from the loop samples to compute loop investments.

In the example above, the first 26 gauge buried cable requires an investment of $0.0250 per pair-foot, and the second cable $0.0200 per pair-foot. A unit investment for 26 gauge buried cable in each geographic zone is computed based on the weighted average of these and other cable sizes in the zone. This average reflects both *feeder* and *distribution* cables.

Since feeder cables tend to be larger than distribution cables, the cable cost per pair-foot for feeder cable is less than the cost of distribution cable. To reflect this difference, the unit investment for feeder and distribution cables combined is "deaveraged" between feeder and distribution cables. This is done in two steps. First, the unit investment for *feeder cable* is calculated based on records of feeder cable sizes and quantities. Then, the unit investment for distribution cable is "solved for" based on the unit investment for feeder and distribution cables combined, the feeder unit investment and the relative proportion of feeder and distribution cable lengths in a geographic zone. Figure 3.4 illustrates the level of detail of cable unit investments for each of three geographic zones.

[4] Cable costs are obtained from Southwestern Bell Engineering's records of current outside plant construction cost data. These data are used by engineers in planning current outside plant construction projects. Cable costs are adjusted to reflect any change in cable cost anticipated in the near future.

Figure 3.4

Geographic Zone

Copper Feeder Cable

	Wire Gauge			
Cable Type	26	24	22	19
Aerial Cable	$0.XXX	$0.XXX	$0.XXX	$0.XXX
Buried Cable	$0.XXX	$0.XXX	$0.XXX	$0.XXX
Underground Cable	$0.XXX	$0.XXX	$0.XXX	$0.XXX

Copper Distribution Cable

	Wire Gauge			
Cable Type	26	24	22	19
Aerial Cable	$0.XXX	$0.XXX	$0.XXX	$0.XXX
Buried Cable	$0.XXX	$0.XXX	$0.XXX	$0.XXX
Underground Cable	$0.XXX	$0.XXX	$0.XXX	$0.XXX

Fiber cable investments / pair-foot are computed for buried and underground cables. First, fiber costs per foot are obtained from Engineering's cable construction cost data. The cable sizes used in the study are 24 fiber cable for zone one, 48 fiber cable in zone 2, and 144 fiber cable in zone 3. Contractor placement costs and innerduct costs (for underground cable) are added. The total installed cost per foot for each cable size then is divided by the number of fibers per cable (24, 48 or 144) to compute the installed cost / fiber-foot.

Four fibers are assumed for each DLC system. Consequently, the installed cost / fiber-foot for each cable size is multiplied by four fibers to compute the installed cost / foot and DLC system. This figure is divided by the voice grade channel capacity of the DLC systems to arrive at fiber cable investments / pair-foot.

3.6 Cable Mix Measurement

The relative proportions or mix of cable types (*percentages of aerial, buried and underground cables*) for loop distribution and feeder cable in the geographic zones is determined by measuring in-service quantities (total cable sheath-feet) of each cable type. Two measurements are required. The first measurement reflects feeder and distribution cable combined. A second measurement is made of only feeder cable. The total feeder cable sheath-feet is subtracted from the total cable sheath-feet to determine the distribution cable in-service quantity. Cable mixes are separately computed for distribution and feeder cables by zone based on the resulting quantities of each cable type.

3.7 Fill Factor Estimation

Fill factors are based on actual plant utilization. A separate fill factor is calculated for feeder cable, distribution cable and DLC systems. The cable factors are computed by dividing the number of working pairs by the number of available and spare pairs in each cable route. The DLC fill factor is based upon actual DLC channel utilization.

3.8 LPVST Model

LPVST is a cost model used to compute forward-looking loop plant investments. It was developed many years ago by the Bell System and is now maintained by Southwestern Bell. The model relies on the cost data described in Sections 3.4 - 3.7. These data include loop lengths divided between distribution and feeder cable for a sample of loops in each geographic zone, cable investments / pair-foot of capacity, cable mixes and fill factors. Two additional input items - pole and conduit plant investment factors - also are used in LPVST to compute the investment in structures required to support cables.

To calculate *loop plant investments for distribution and feeder cable* by geographic zone the following steps are used by LPVST.

- *Frequency distribution of loop lengths*. The distribution and feeder cable lengths for each loop sample are assigned to a "mileage band" based on the distribution and feeder cable measurements provided by the LEIS data base. The mileage bands are in 1,000' increments, beginning with 0 - 1,000', 1,000 - 2,000', and so on. A loop with a distribution cable length of, say, 5,542' would fall in the 6,000' mileage band, and a loop with 4,420' of distribution cable would be in the 4,000' mileage band. (The dividing point between bands is the mid-point; loop lengths are rounded to the nearest band.) By assigning each loop to one of the mileage bands, the *frequency distribution* of loop lengths is determined. It shows the percentage of loops in a geographic zone which are expected to fall in each mileage band.

- *Distinction of loops with copper and fiber feeder cable*. Loops with feeder cables above and below the copper - fiber cutover point (15,000') are separated. Therefore, for each geographic zone there actually are three frequency distributions - one for the distribution cable portion of loop length, another for the feeder cable portion of the loop when the loop design calls for copper feeder cable, and the third for the feeder cable portion of the loop when fiber cable is used. The three distributions, in effect, are used to compute average lengths of distribution cable, copper feeder cable and fiber feeder cable.

- *Mix of wire gauge*. LPVST also distinguishes the mix of wire gauges for copper distribution and feeder cables. Since the electrical resistance in copper wire increases with length, LPVST contains tables which indicate the maximum distance at which the smallest gauge wire (26 gauge) can be used, at which point the next size wire (24 gauge) is used until its limit is reached, followed by 22 gauge and then 19 gauge wires. Thus, LPVST estimates the average length and mix of wire gauges for copper distribution and feeder cables in rural, mid-sized and urban wire centers.[5]

- *Mix of cable types*. In the proceeding steps, LPVST computes average copper distribution and feeder lengths by wire gauge, and an average fiber feeder cable length. Since the cables are a mix of aerial, buried and underground cable, the next step is to apply the percentages of each cable type to the average lengths. These percentages vary for copper distribution, copper feeder and fiber feeder cables.

- *Cable investments / pair-foot in service*. Section 3.5 described the special study used to compute cable investments / pair-foot of *capacity* for each cable type. Because not all cable pairs will be in service, it is necessary to adjust the cable unit investments to reflect expected utilization. This is done by dividing the unit investment for each cable type by its corresponding fill factor. (See Section 3.7.) This calculation yields an amount equal to the cable investment / pair-foot *in service*.

- *Loop investments*. The cable investments / pair-foot in service then are applied to the average cable lengths to determine the investment in distribution and feeder cables in each geographic zone.

- *Structures investment*. In addition to the investment in cable, loops also require investment for poles and conduit. These investments are calculated by applying ratios of structure investment to cable investment to the aerial and underground cable portions of loop investment. This step completes the LPVST investment calculations, and the results are carried forward to be summarized with the digital loop carrier and other loop component investments described in Sections 3.9 and 3.10.

3.9 Digital Loop Carrier Investment

Digital loop carrier (DLC) systems are assumed for loops with *feeder cable lengths* above a certain threshold - typically 15,000 feet. A DLC system consists of digital electronic circuit equipment which enables many voice channels to be combined over the same fiber. This is accomplished using "time-division multiplexing." The result is lower costs and better transmission than traditional copper cables for loops with long feeder cable lengths.

Three sizes of DLC systems are used in the unbundled loop cost study. The smallest system has a capacity of 192 voice channels and is used in the rural geographic zone. The second system has 692 channels of capacity and is used in the mid-size geographic zone. The third system handles up to 1,344 channels in the urban zone.

One of the key factors underlying DLC costs is whether the system is "integrated" with the serving end office. An integrated DLC system is connected directly to the switching system such that digital signals from subscribers do not have to be "demultiplexed" and converted to analog signals.

[5] Gauge measurements do not apply to *fiber* feeder cable. In this case, LPVST simply determines average feeder cable length for loops with feeder cable exceeding the 15,000' threshold for fiber cable.

This saves from having to have *central office terminating equipment* for the DLC system. Non-integrated DLC systems require central office terminating equipment to demultiplex signals and covert them to analog signals as they were before entering the DLC system. In both cases, DLC equipment, called *remote terminating equipment*, is required in the field. The unbundled loop cost study calculates DLC investment per loop reflecting the relative frequency of integrated and non-integrated systems.

DLC investments are computed in a special study which identifies the equipment components, quantities, current material prices and engineering and labor to construct the three sizes of DLC system. DLC investments per loop are calculated by dividing the DLC investments by the expected channel utilization for each system. The latter is computed by dividing the physical capacity of each system (192, 672 or 1,344 voice channels) by the DLC system fill factor. This factor reflects the expected utilization of the system.

3.10 Other Loop Components

The investments in distribution and feeder cables and the digital loop carrier system typically represent 90% or more of the investment in loop plant. There are, though, several other important loop components included in the study. These are illustrated in Figure 3.2 and described below:

- *Premises termination equipment (NID, drop cable and terminal).* An 8db loop requires a single premises termination with a one or two pair drop cable. Investments are computed for one and two pair drop cables and weighted based upon the frequency of each. Premises termination investment includes the equipment costs of the network interface device, drop cable and terminal, as well as labor costs for installing the equipment and cable splicing. Cost data are from Engineering's outside plant construction cost data.

- *Feeder distribution interface (FDI).* The FDI investment represents the cost of the cabinet and equipment providing the cross-connect point between the feeder and distribution cables. FDI investment per loop is computed based on an analysis of the number of FDI boxes of various line sizes and the installed costs of each.

- *Feeder stub.* The feeder stub investment is calculated based on an average feeder stub length derived from a random sample and the installed cost / pair-foot for feeder stub cable. The unit investment for the stub cable is divided by the fiber feeder cable fill factor to allow for the cost of spare capacity in the feeder stub.

- *Main distributing frame stringer.* Frame stringer investments include the costs of a protector unit and protector block, the riser cable connecting the outside plant cable to the main distributing frame, and installation labor. Investments are calculated for copper feeder cables and fiber feeder cables. Unit investments are increased by the copper or fiber feeder cable fill factors to recognize the costs of spare frame stringer equipment.

After these special studies for the other loop components are completed, loop investments are summarized for each geographic zone on a "loop spreadsheet" Figure 3.4 illustrates the type of cost information which is contained. Note that the investments for copper and fiber feeder cables, the DLC system and the feeder stub are multiplied times a frequency factor to reflect the percentage of loops which are provided using these components. The primary purpose of the loop spreadsheet is to summarize loop investment by account so that capital cost and operating expense factors can be applied to the investments in ACES to calculate recurring monthly costs.

Figure 3.4

Geographic Zone

Loop Component	Frequency	Copper Aerial Cable	Copper Buried Cable	Copper Underground Cable	Fiber Buried Cable	Fiber Underground Cable	Poles	Conduit	Circuit Equipment	COE Frame
Premises Termination	100%	$XX.XX	$XX.XX							
Distribution Cable	100%	$XX.XX	$XX.XX	$XX.XX			$XX.XX	$XX.XX		
Feeder - Distribution Interface	YY%		$XX.XX							
Feeder Cable										
Copper	XX%	$XX.XX	$XX.XX	$XX.XX			$XX.XX	$XX.XX		
Fiber	YY%				$XX.XX	$XX.XX	$XX.XX	$XX.XX		
Feeder Stub	YY%		$XX.XX							
DLC System	YY%								$XX.XX	
MDF Stringer	100%									$XX.XX
		$XX.XX	$XX.XX	$XX.XX	$XX.XX	$XX.XX	$XX.XX	$XX.XX	$XX.XX	$XX.XX

Note: XX% + YY% = 100%

3.11 Automated Cost Extraction System (ACES)

ACES has two purposes. The first is to add additional capitalized costs for sales taxes, telco engineering and labor, miscellaneous materials, power equipment and buildings to house equipment, if these amounts have not already been included in previous calculations. Secondly, ACES computes recurring monthly capital costs and operating expenses based on plant investments for the network elements. These computations are based on capital cost and operating expense factors entered in ACES. (See Sections 8, 9 and 10.)

The calculations performed by ACES are straightforward as illustrated by the examples of the two pages of ACES output shown in Figures 3.5 and 3.6. The first page shows input cost data. There is one page for each plant account to allow for differences in depreciation rates, equipment maintenance and other cost factors which vary among types of plant.

- *Total Equipment Investment*. This is the amount of investment by plant account necessary to provide a unit of demand for the network element, such as an unbundled loop. The figure is from the LPVST model or one of the other component investment studies.

- *Investment Loadings*. Lines 2 - 12 contain factors used to compute the additional costs of construction for telco engineering and labor, power equipment, etc. Some of these values will be zero if they do not apply or have already been included in the investment calculations.

- *Capital Cost Data.* Lines 14 - 16 provide the factors which are multiplied times the network element investments to compute annual capital costs - depreciation, the cost of money and income taxes. The factors are calculated in the CAPCOST model based on plant service lives, net salvages, the cost of money, the debt ratio, income tax rate and other factors. The ACES input sheet also shows inflation factors for capital costs and operating expenses. The capital cost inflation factor is used to inflate (or possibly deflate) the current investment and related capital costs to reflect a *future planning period*.

- *Annual Expense Data.* Lines 18 - 22 contain factors used to compute recurring operating expenses. The first four factors are multiplied times the network element investment to compute recurring annual expenses. The maintenance factors determine expenses for plant maintenance, and depending on the plant type may include expenses for testing and power. The administrative expense factor includes various network administration, engineering and support asset expenses. The ad valorem tax factor captures the cost of taxes levied on the value of plant. And finally, the commission assessment factor is used to "gross-up" the subtotal of the preceding capital costs and operating expenses to calculate the taxes charged on revenues received in providing network elements. *Operating expense factors exclude any retail marketing expenses.*

The second page of ACES output shown in Figure 3.6 shows the calculations of the additional investment amounts, capital costs and operating expenses. Each line of calculations is clearly described on the output page.

Output from ACES consists of an annual cost figure for each plant account. These are summed and simply divided by 12 months per year to compute the monthly loop costs shown in Figure 3.1. This completes the study for the recurring monthly costs of an unbundled loop.

Figure 3.5 - ***Illustrative***

To Schedule A
02/19/97

KANSAS 1997
KANSAS TEST STUDY
INPUTS SHEET
TEST INVESTMENT

97-KS-UCS-7821 V2.1
EQUIPMENT INVESTMENT:

	(Input)	(TPI)	(Weight Factor)		
	1000	* 1.000000	* 1.000000	=	$1,000.00

1	EQUIPMENT INVESTMENT (EF&I)				$1000.00	
2.	RATIO OF MATERIAL TO TOTAL EF&I				0.85000	
3.	SALES TAX			0.050000	$42.50	8/30/96
4.	TOTAL EF&I INVESTMENT (EF&I)				$1042.50	8/30/96
5.	TELCO Engineering			0.030000	$31.28	8/30/96
6.	TELCO Plant Labor			0.050000	$52.13	8/30/96
7.	Sundry & Miscellaneous			0.010000	$10.43	8/30/96
8.	Total Installed Cost				$1136.34	8/30/96
9.	Power Investment			0.080000	$90.91	8/30/96
10.	Total Equipment Investment				$1227.25	8/30/96
11.	Total Unit Investment With Fill			1.000000	$1227.25	8/30/96
12.	Building Investment Per Unit			0.460000	$564.54	8/30/96
13.	Total Unit Investment				$1791.79	8/30/96
	ANNUAL CAPITAL COSTS					
14.	DEPRECIATION	- Equipment	(Inf * 0.1077)	0.110000		
		- Building	(Inf * 0.0294)	0.030000	$151.93	8/30/96
15.	COST OF MONEY	- Equipment	(Inf * 0.0489)	0.050000		
		- Building	(Inf * 0.0783)	0.080000	$106.53	8/30/96
16.	INCOME TAX	- Equipment	(Inf * 0.0196)	0.020000		
		- Building	(Inf * 0.0294)	0.030000	$41.48	8/30/96
17.	TOTAL ANNUAL CAPITAL COSTS				$299.94	
	ANNUAL OPERATING EXPENSE					
18.	EQUIPMENT MAINTENANCE		(OEInf * 0.0843)	0.090000	$110.45	8/30/96
19.	BUILDING & GROUNDS MAINTENANCE		(OEInf * 0.0094)	0.010000	$5.65	8/30/96
20.	ADMINISTRATION EXPENSE		(OEInf * 0.0375)	0.040000	$71.67	8/30/96
21.	AD VALOREM TAXES			0.020000	$35.84	8/30/96
22.	COMMISSION ASSESSMENT			0.010000	$5.24	8/30/96

*	Inf	Capital Cost Inflation Factor	97-99	1.0217
*	OEInf	Operation Expense Inflaction Facto	97-99	1.0674